MAE 5070 **Exercise Set I** February 9, 2011

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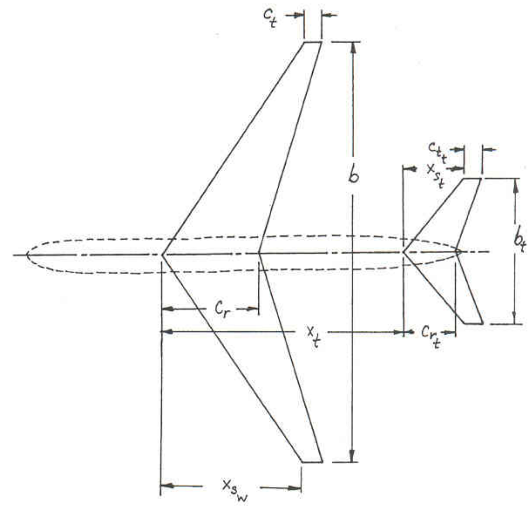
The three-view drawing at the bottom of the page shows the general layout of the Boeing 747 aircraft. For the purpose of estimating the longitudinal aerodynamic characteristics of the vehicle, we will assume the planforms of the lifting surfaces can be approximated by the trapezoidal areas in the sketch on the right.
The relevant dimensions can be taken as follows:



Wing:	**Tail:**
$S = 5500.\ \text{ft}^2$	$S_t = 1460.\ \text{ft}^2$
$b = 195.7$ ft	$b_t = 73.3$ ft
$c_\text{r} = 43.5$ ft	$c_{\text{r}_\text{t}} = 31.8$ ft
$c_\text{t} = 12.71$ ft	$c_{\text{t}_\text{t}} = 8.05$ ft
$x_{\text{s}_\text{w}} = 83.9$ ft	$x_{\text{s}_\text{t}} = 32.0$ ft
	$x_t = 126.3$ ft

1. Estimate the mean aerodynamic chord of the wing $\bar{c}_w$ and tail $\bar{c}_t$, and the positions of the aerodynamic centers of the wing and tail. Specify all locations measured from the wing apex.

2. Estimate the stability derivatives $\mathbf{C}_{L\alpha}$ and $\mathbf{C}_{m\alpha}$ and the location of the basic neutral point for the given configuration at the two conditions given in the table below. Assume the vehicle center of mass is located at $0.25\ \bar{c}$ (i.e., at the assumed location of the *wing* aerodynamic center), and express the location of the neutral point in terms of percent mean aerodynamic chord.

Note: In estimating the stability characteristics, use the formula given in class (and in the lecture notes) to estimate the downwash at the tail (with $\kappa = 1.5$), and assume $\eta = Q_t/Q = 0.95$. Also, estimate the volume of the effective fuselage by approximating it as a circular cylinder having diameter $d_f = 20$ ft and length $\ell_f = 190$ ft.

Condition:	**1**	**2**
h (ft)	0. (SSL)	40,000
Mach Number	0.250	0.80
Airspeed (ft/sec)	279.1	774.5
Gross Weight (lbf)	564,000.	636,600.